Amendments to the Drawings

Kindly replace previous formal drawing sheet 8/10 of the application with the replacement formal drawing sheet 8/10 presented herewith.

Attachments: Replacement Formal Drawing Sheet 8/10; and
Mark-Up Drawing Sheet 8/10

Remarks

Entry of this amendment and allowance of all claims are respectfully requested. Claims 1-3, 5-7, 10-17, 19, 22-27, 30-36, 38, 41-43, 45-47, 50-57, 59 & 62 remain pending.

Initially, Applicants note that a Replacement Formal Drawing Sheet 8/10 is presented herewith. In this Replacement Drawing Sheet, the typographical error "TORAL" is corrected to the word "TOTAL". A Mark-Up Formal Drawing Sheet 8/10 highlighting the correction in red is also submitted with this paper.

By this paper, independent claims 1, 16, 23, 36, 42 & 56 are amended to more clearly point out and distinctly claim certain aspects of the present invention. Support for the amended claims can be found in canceled dependent claims 4, 8, 9, 18, 20, 21, 28, 29, 37, 39, 40, 44, 48, 49, 58, 60 & 61, which again are canceled herein without prejudice. These amendments are submitted in a *bona fide* attempt to further prosecution of the subject application. No new matter is added to the application by any amendment presented.

In the final Office Action, claims 1-12, 15-32, 35-52 & 55-62 were rejected under 35 U.S.C. §103(a) as being unpatentable over Keesman et al. (U.S. Patent No. 5,805,220; hereinafter Keesman), in view of Uz et al. (U.S. Patent No. 5,764,293; hereinafter Uz), while claims 13-14, 33-34 & 53-54 were rejected under 35 U.S.C. §103(a) as being unpatentable over Keesman in view of Uz, and further in view of Nam et al. (U.S. Patent No. 5,617,150; hereinafter Nam). These rejections are respectfully, but most strenuously, traversed to any extent deemed applicable to the claims presented herewith, and reconsideration thereof is requested.

Applicants present in this application an exchange interface which allows multiple encoders to share a constant channel rate in a statistical multiplex system. The exchange interface allows a joint rate control function to be distributed among the encoders, thereby providing effective system-wide joint rate control without employing any external rate control processing. The encoder architecture of this invention is a compact, simple system, designed to accommodate the encoding of multiple concurrent programs. (See paragraph [0020] of Applicants' specification.)

More particularly, Applicants' invention is directed, in one aspect, to a technique for processing multiple streams of video frames (e.g., see independent claims 1, 16, 23, 36, 42 & 56). The technique includes employing multiple encode processes to encode multiple streams of video frames in parallel. Further, there is a direct exchanging encode process to encode process of at least one input statistic or encode statistic employed by each encode process of the multiple encode processes. In addition, the technique includes dynamically adapting encoding of at least one stream of video frames of the multiple streams of video frames based on the relative complexity of the video frames comprising the multiple streams of video frames employing the at least one input statistic or encode statistic directly exchanged between the encode processes. In Applicants' invention, there is a distributed control strategy integrated within the encode processes themselves which allows the dynamic adjustment of the encoding of one or more streams of video frames responsive to the direct exchanging encode process to encode process.

The independent claims further characterize Applicants' technique by stating that each encode process of the multiple encode processes ascertains the at least one input statistic or encode statistic for its respective stream of video frames being encoded, saves the at least one input statistic or encode statistic, and shares the at least one input statistic or encode statistic directly with the multiple encode processes during the exchanging to allow determination by at least one encode process of the multiple encode processes of a total statistic corresponding to a sum of the at least one input statistics or encode statistics generated by the multiple encode processes. Further, Applicants' technique is characterized by stating that the directly exchanging further includes sharing the total statistic among the multiple encode processes, wherein at least one encode process employs the total statistic and its own at least one input statistic or encode statistic during the dynamically adapting encoding to facilitate the dynamically adapting encoding of the at least one stream of video frames of the multiple streams of video frames.

Applicants respectfully submit that at least the above-noted further characterizations of Applicants' technique are not taught or suggested by the applied or known art.

An "obviousness" determination requires an evaluation of whether the prior art taken as a whole would suggest the claimed invention taken as a whole to one of ordinary skill in the art. In evaluating claimed subject matter as a whole, the Federal Circuit has expressly mandated that functional claim language be considered in evaluating a claim relative to the prior art.

Applicants respectfully submit that the application of these standards to the independent claims presented leads to the conclusion that the recited subject matter would not have been obvious to one of ordinary skill in the art based on the applied patents.

Keesman discloses a system for transmitting a plurality of video programs simultaneously through a transmission channel having a predetermined bitrate. The system includes in cascade a decoding assembly and an encoding assembly. The decoding assembly consists of n parallel decoding means provided in parallel for decoding the coded input signals corresponding to the programs, and the encoding assembly consists of n encoding means in cascade with each of the decoding means and each including a quantizer having a variable step size and a variable length encoder. The system also includes means for controlling the step sizes of the encoding means in dependence upon their respective output bitrates, and these control means are also provided for controlling the output bitrates of the encoding means in dependence upon complexity values associated to the coded input signals of each decoding means with respect to the joint complexity of the plurality of the coded signals. (See Abstract of Keesman.)

Although Keesman does describe a technique for parallel encoding of multiple streams of video frames, the technique employed is clearly distinct from that recited by Applicants in the claims presented. For example, Applicants recite in each independent claim the direct exchanging encode process to encode process of at least one input statistic or encode statistic employed by each encode process of the multiple encode processes. There is no similar facility in Keesman for directly exchanging encoder to encoder of one or more statistics. Rather, Keesman teaches one encode approach such as depicted in FIG. 3 of the present application wherein the external joint rate controller 230 of Applicants' FIG. 3 is equivalent to the joint bit rate adjusting circuit 5 depicted in Fig. 1 of Keesman. However, Applicants' recited invention does not employ an external joint rate controller such as shown in their FIG. 3, and such as taught by Keesman in Fig. 1 thereof. Rather, Applicants recite a direct exchanging encoder to encoder (or encode process to encode process) of the one or more input statistic or encode statistic employed by each encoder of the multiple encoders. Further, Applicants recite dynamically adapting encoding of at least one stream of video frames of the multiple streams of video frames based on the relative complexity of the video frames comprising the multiple streams of video frames by employing the at least one input statistic or encode statistic directly exchanged between the encode processes. Applicants employ a joint rate control strategy that is

distributed within the multiple encode processes themselves, and thus, there is a direct exchanging of one or more encode statistics between the encode processes for use in the dynamically adapting. No similar functionality is taught or suggested by Keesman, or the other art of record. Keesman does not depict or suggest the integration of a facility for exchanging encode process to encode process of one or more input statistic or encode statistic employed by each encode process of the multiple encode processes, let alone a dynamic adjustment being made by one of the encode processes based thereon.

The final Office Action recognizes certain of the above-noted deficiencies of Keesman when applied against the independent claims previously pending. Specifically, the Office Action recognizes that Keesman fails to disclose the direct communication between encoders as claimed. However, the Office Action then cites Uz for the broad concept of "directly exchanging encode process to encode process" to facilitate rate control, wherein FIGS. 1A & 1B of Uz are cited as illustrative of the direct communication.

Without acquiescing to the above-noted characterization of Uz stated in the Office Action, Applicants respectfully submit that a careful reading thereof fails to disclose any teaching or suggestion of Applicants' invention as recited in the claims presented herewith. Specifically, Applicants further characterize each independent claim to state:

(1) wherein each encode process of the multiple encode processes ascertains the at least one input statistic or encode statistic for its respective stream of video frames being encoded;

(2) each encode process of the multiple encode processes saves the at least one input statistic or encode statistic;

(3) each encode process of the multiple encode processes shares the at least one input statistic or encode statistic directly with the multiple encode processes during the exchanging to allow determination *by at least one encode process of the multiple encode processes of a total statistic corresponding to a sum of the at least one input statistic or encode statistics generated by the multiple encode processes*;

(4) the directly exchanging further includes sharing the total statistic among the multiple encode processes; and

(5) at least one encode process employs the total statistic and its own input statistic or encode statistic during the dynamically adapting encoding to facilitate the dynamically adapting encoding of the at least one stream of video frame of the multiple streams of video frames.

Applicants respectfully submit that a careful reading of Uz, and Keesman, fails to uncover any teaching or suggestion of a joint rate control strategy distributed among the multiple encode processes and functioning in a manner as outlined above. This subject matter was previously recited in, in part, Applicants' dependent claims 8, 9, 28, 29, 48 & 49, which stand rejected in the final Office Action based on certain teachings of Keesman at column 3, lines 46-54. This conclusion is respectfully, but most strenuously traversed.

At column 3, lines 46-54, Keesman describes the proportioning of a constant channel bit rate among the transcoding programs in the system. However, the bit rate proportioning is carried out by the centralized joint bit rate adjusting circuit that is external to all encoding processes in the system. In Keesman, video complexities are visible to the external joint bit rate adjusting circuit only, and not to the individual encode processes, as is the case with Applicants' recited invention. In Applicants' recited invention, statistics are visible to all encode processes via the direct communication among the encode processes. Applicants respectfully submit that a careful consideration of the above-noted characterizations of Applicants' joint rate control strategy distributed among the multiple encode processes, leads to the conclusion that the recited subject matter would not have been obvious over Keesman, alone or in combination with Uz. There is simply no teaching or suggestion of many, if not all, of the above-noted characterizations (1)-(5) of Applicants' distributed control strategy.

For at least this reason, reconsideration and withdrawal of the obviousness rejection to the claims presented herewith is respectfully requested.

Uz describes a rate control algorithm for an MPEG-2 encoder. The rate control algorithm has embodiments useful for constant bit rate and variable bit rate encoding. FIG. 1A of Uz schematically illustrates an architecture of an encoder which may be utilized to generate an MPEG-2 compliant bitstream, while FIG. 7A thereof illustrates a statistical multiplexing system in which a plurality of encoders of the type shown in FIG. 1A communicate with a central control unit. (See column 7, lines 10-13 & 30-33 of Uz.)

A careful reading of Uz uncovers that the patent describes a centralized rate control concept among encoders, each of the type shown in FIG. 1A. At column 18, line 45 – column 19, line 4, Uz describes a statistical multiplexing function. It describes the architecture of bit rate allocation among multiple streams. As shown in FIG. 7A of Uz, the central controller 210 is the joint rate controller external to the encoders 200-1 to 200-n. Each encoder (of the 1 to n) reports status to the central controller and receives encoding parameters such as bit rate from it. Thus, the basic principle of the system joint rate control is handled by a centralized control scheme. It is clear from FIG. 7A that there is no communication lines between the 1-n encoders. Such communication lines are not needed in a centralized joint rate control system.

In FIG. 1A, Uz depicts an architecture to encode a single stream. Each encoder unit is used to encode a section of a picture, with an example of four macro-blocks high being given. Uz's description concentrates on the rate control function, and does not describe the interfaces between the encoders. This implies that the interfaces are not specific to the rate control function.

Although not cited with respect to the subject matter of the amended independent claims, Applicants respectfully submit that Uz does not teach or suggest the noted functionality. A careful reading of Uz fails to uncover any discussion of the above-noted characterizations (1) – (5) of Applicants' amended independent claims. For this additional reason, Applicants respectfully submit that the independent claims presented herewith patentably distinguish over the applied art. Reconsideration and withdrawal of the obviousness rejection to the independent claims is therefore respectfully requested.

The dependent claims are believed allowable for the same reasons as the independent claims, as well as for their own additional characterizations. For example, dependent claims 2, 17, 24, 37, 43 & 57 each recite an exchange interface within the multiple encode processes, wherein the exchange interface facilitates the directly exchanging encode process to encode process of the at least one input statistic or encode statistic. Various of these claims recite that the direct exchange interface includes dedicated data and control busses directly connecting the multiple encoders for facilitating encoder to encoder exchanging of statistics. A careful review of Keesman fails to uncover any analogous concept. The Office Action cites the adjusting circuit 5, in column 3, lines 23-37 of Keesman. However, as noted above, the adjusting circuit 5 and the discussion thereof at column 3 refers to a control technique that is implemented external to the encoders, as clearly shown by Fig. 1 of Keesman wherein encoding devices 12, 62 are separate from adjusting circuit 5. Further, there is no direct communication between the encoders shown in Keesman, and there is no exchange of input statistics or encode statistics directly between the encoders as recited by Applicants.

As noted, dependent claims 13, 14, 33, 34, 53 & 54 stand rejected as obvious over Keesman in view of Uz and Nam. Reconsideration of this rejection is respectfully requested for the reasons noted above with respect to the independent claims. The Office Action notes that Keesman and Uz do not teach the modifying being accomplished at a group of picture boundary or scene change in the stream of video frames being encoded by the at least one encode process, and therefore, cites the teachings of Nam. Without acquiescing to the characterizations of Nam stated in the Office Action, Applicants note that a careful reading of Nam fails to uncover any teaching or suggestion of the above-noted deficiencies of Keesman and Uz when applied against the independent claims presented. Thus, Applicants respectfully request reconsideration and withdrawal of the obviousness rejection to these dependent claims.

For at least the above reasons, all claims submitted herewith are believed to be in condition for allowance, and such action is respectfully requested.

If a telephone conference would be of assistance in advancing prosecution of the subject application, Applicants' undersigned attorney invites the Examiner to telephone him at the number provided.

Respectfully submitted,

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MARK-UP DRAWING SHEET

KEY FOR FIG. 8B

i	ENCODER INDEX. (1 THRU n)
n	INDEX OF LAST ENCODER IN SYSTEM
SUM	CONTROL WORD WRITTEN TO COMMAND (CMD) BUS SIGNALING THE SUMMING OF THE VALUE BEING PASSED
TOTAL	CONTROL WORD ~~WRITTEN~~ TO CMD BUS SIGNALING THE (TORAL) OF THE VALUE BEING PASSED -- TOTAL --
V	VALUE READ FROM THE DATA BUS
V_i	VALUE CALCULATED BY EACH INDIVIDUAL ENCODER$_i$
V_{SND}	VALUE WRITTEN TO DATA BUS
V_T	TOTAL VALUE (SAVED BY ENC$_i$)
==	MEANS EQUAL TO
=	MEANS IS BEING ASSIGNED THE VALUE OF

fig. 8A